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Kootenai County, Idaho

National Eutrophication Survey, Las Vegas, Nev

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

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REPORT

ON

HAUSER LAKE

KOOTENAI COUNTY

IDAHO

EPA REGION X

WORKING PAPER No. 780

WITH THE COOPERATION OF THE

IDAHO DEPARTMENT OF HEALTH AND WELFARE

AND THE

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT ON HAUSER LAKE

KOOTENAI COUNTY, IDAHO

EPA REGION X

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

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U.S. ENVIRONMENTAL PROTECTION AGENCY

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Idaho Department of Health and Welfare for professional involvement, to the Idaho National Guard for conducting the tributary sampling phase of the Survey, and to those Idaho wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the State of Idaho Department of Health and Welfare, Division of Environment, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

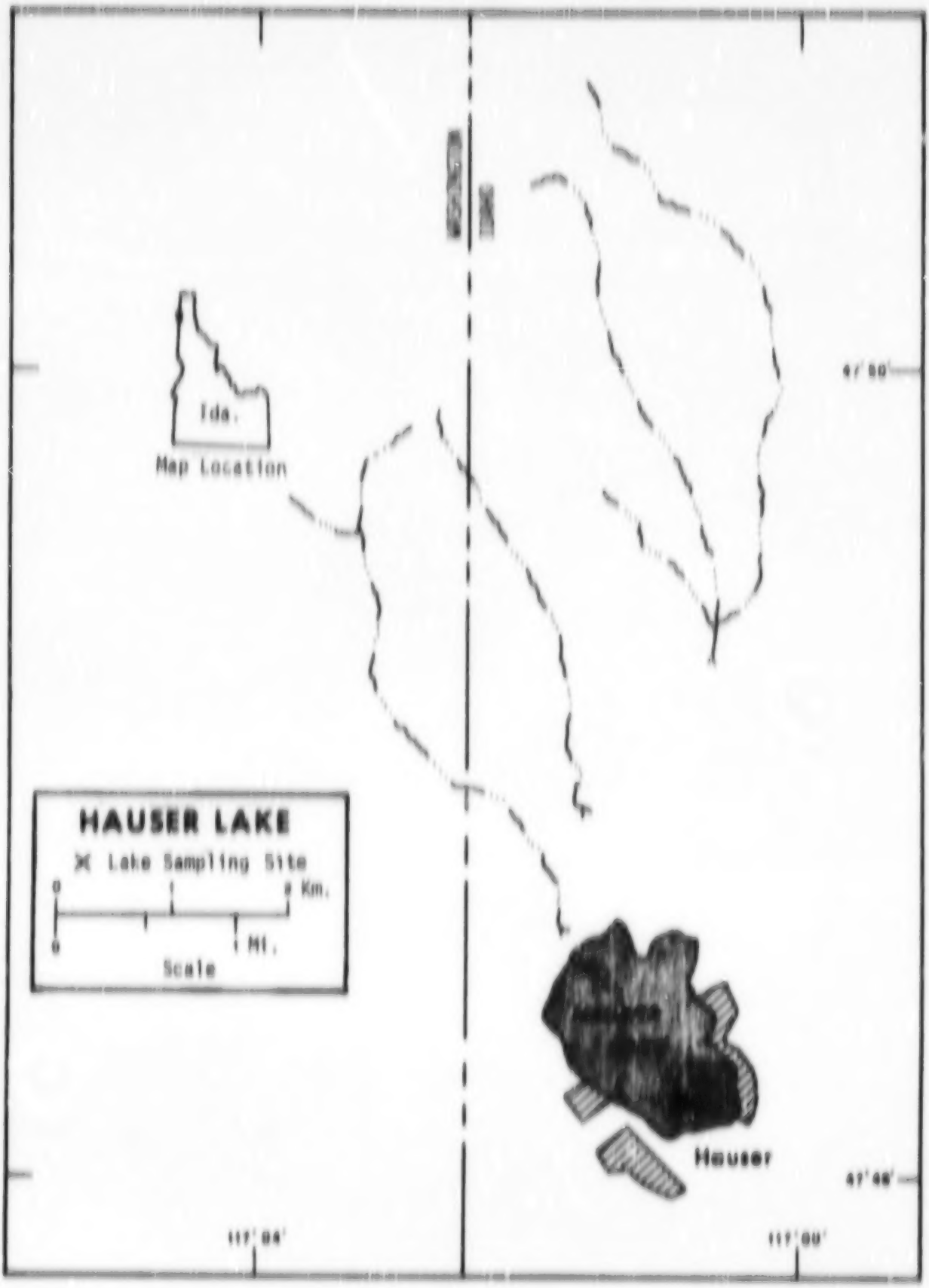
Major General James S. Brooks, Adjutant General of Idaho, and Project Officer Major Vestal L. Baker, who directed the volunteer efforts of the Idaho National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IDAHO

LAKE NAME	COUNTY
American Falls Reservoir	Bannock, Bingham, Power
Cascade Reservoir	Valley
Coeur d'Alene Lake	Benewah, Kootenai
Dworshak Reservoir	Clearwater
Hauser Lake	Kootenai
Hayden Lake	Kootenai
Island Park Reservoir	Fremont
Lake Lowell (Deer Flat Reservoir)	Canyon
Magic Reservoir	Blaine, Camas
Palisades Reservoir	Bonneville (Lincoln in WY)
Payette Lake	Valley
Lower Twin Lake	Kootenai
Upper Twin Lake	Kootenai


Ida.
Map Location
47°50'
47°48'
117°04'
117°00'
HAUSER LAKE
Lake Sampling Site
0
2 Km.
0
1 Mi.
Scale
Hauser

REPORT ON HAUSER LAKE, IDAHO

STORET NO. 1605

I. INTRODUCTION

Hauser Lake was included in the National Eutrophication Survey (NES) as a water body of special interest to the Idaho Department of Health and Welfare. Tributaries and nutrient sources were not sampled, and this report relates only to the data obtained from lake sampling.

II. CONCLUSIONS

A. Trophic Condition:*

Based upon Survey data, Hauser Lake is considered eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of each lake.

Chlorophyll a levels in the lake ranged from 1.8 ug/l to 36.6 ug/l with a mean of 11.1 ug/l. Hypolimnetic oxygen levels in the lake were severely depressed during September, and the potential for primary productivity as measured by algal assay control yields was high during September and October. Of the 13 Idaho lakes sampled in 1974, 6 had higher median total phosphorus, 4 had higher median inorganic nitrogen and 3 had higher median orthophosphorus levels than

*See Appendix C.

Hauser Lake: ammonia and phosphorus were especially high in the hypolimnion at Station 01 during September and October.

Survey limnologists reported algal blooms and floating algal mats throughout the lake in June and July, as well as some floating aquatic macrophytes (water lilies, duckweed). Other studies (Idaho Department of Water Resources, et al. 1975) indicate poor water quality in Hauser Lake can be mainly attributed to excessive residential development with inadequate septic systems, and agricultural runoff.

B. Rate-Limiting Nutrient:

The algal assay results indicate Hauser Lake was limited by available phosphorus during June sampling, but by nitrogen during September and October assay sample collections. The lake data suggest primary limitation by nitrogen on all sampling occasions.

III. LAKE CHARACTERISTICS

A. Lake Morphometry:*

1. Surface area: 2.43 km^2.
2. Mean depth: 1.2 meters.
3. Maximum depth: 12.2 meters.
4. Volume: 2.837 x 10^6 m^3.

B. Precipitation:

1. Year of sampling: 86.1 cm.
2. Mean annual: 84.2 cm.

*Lake surface area, mean depth and volume provided by Herman Ray (1976). Maximum depth was estimated on the basis of National Eutrophication Survey (NES) sampling data.

IV. LAKE WATER QUALITY SUMMARY

Hauser Lake was sampled four times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 10.7 meters at Station 01 and 7.3 meters at Station 02. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix B and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

[illegible]

[illegible] PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	N*	[illegible]	[illegible]	[illegible]	[illegible]
TEMPERATURE (DEG. C)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
DISSOLVED OXYGEN (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
CONDUCTIVITY (UMHO)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
PH (STANDARD UNITS)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL ALKALINITY (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL P (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
DISSOLVED SILICA - (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
NITRATE (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
CHLORIDE (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
FLUORIDE, F (MG/L)					
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
SECCHI DISC (METERS)					
	2	[illegible]	[illegible]	[illegible]	

* N = NO. OF SAMPLES
** MINIMUM DEPTH SAMPLED AT EACH SITE
*** N = NO. OF SITES SAMPLED ON EACH DATE

[illegible]

[illegible] PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	NO.	[illegible]	[illegible]	[illegible]	[illegible]	NO.	[illegible]	[illegible]	[illegible]	[illegible]	NO.	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2	[illegible]	[illegible]	[illegible]		1	[illegible]	[illegible]	[illegible]		2	[illegible]	[illegible]	[illegible]	

* n = NO. OF SAMPLES
** MEDIAN DEPTH SAMPLED AT EACH SITE
*** n = NO. OF SITES SAMPLED IN PAST DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/03/75	1. Cryptomonas	459
	2. Ankistrodesmus	153
	3. Unidentified cell	92
	4. Nitzschia	61
	Other genera	[illegible]
	Total	765
07/23/75	1. Chroomonas	260
	2. Tabellaria	186
	3. Asterionella	74
	4. Cryptomonas	74
	5. Dinobryon	74
	Other genera	112
	Total	780
09/10/75	1. Aphanizomenon	2,225
	2. Melosira	805
	3. Euglena	284
	4. Chlamydomonas	189
	5. Tabellaria	189
	Other genera	568
	Total	4,260
10/23/75	1. Cryptomonas	217
	2. Chroomonas	186
	3. Melosira	186
	4. Schroederia	186
	5. Mallomonas	62
	Other genera	29
	Total	866

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
06/03/75	01	1.8
	07	1.9
07/23/75	01	10.0
	02	11.1
09/10/75	01	30.6
	02	11.8
10/23/75	01	6.1
	02	2.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 06/03/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.010	0.040	0.6
0.05 P	0.060	0.040	2.0
0.05 P + 1.0 N	0.060	1.040	19.2
1.00 N	0.010	1.040	0.6

b. 09/10/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.045	0.190	11.6
0.05 P	0.095	0.190	12.9
0.05 P + 1.0 N	0.095	1.190	37.4
1.00 N	0.045	1.190	15.6

c. 10/23/75

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.095	0.220	10.3
0.05 P	0.145	0.220	10.6
0.05 P + 1.0 N	0.145	1.220	35.0
1.00 N	0.095	1.220	32.3

F. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity in Hauser Lake was moderate during June sampling, but extremely high during September and October. In the June assay, a significant increase in yield occurred when phosphorus was added alone and in combination with nitrogen indicating phosphorus limitation. The addition of only nitrogen resulted in a yield which was not significantly greater than that of the control.

In the September and October assays, the addition of nitrogen alone produced significant increases in yield over those of the controls, indicating nitrogen limitation in the lake at those times.

The mean inorganic nitrogen to orthophosphorus ratios (N/P) in the lake data were less than 6/1 on all sampling occasions, suggesting nitrogen limitation (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

V. LITERATURE REVIEWED

Idaho Department of Water Resources, Department of Health and Welfare, Department of Fish and Game, and Department of Budget, Policy Planning and Coordination. 1975. Idaho Environmental Overview. Boise, Idaho.

Ray, Herman. 1976. Personal communication. (morphometric data of selected Idaho water bodies). Boise, Idaho.

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

VI. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

PHYSICAL AND CHEMICAL DATA

[illegible]

APPENDIX C

PARAMETRIC RANKINGS OF LAKES
SAMPLED BY NES IN 1975

STATE OF IDAHO

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of Idaho lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in ug/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLRA	15- MIN 30	MEDIAN SECC SMTHD P
1601	AMERICAN FALLS RESERVOIR	0.105	0.088	443.790	15.379	14.700	0.035
1602	CICCADE LAKE	0.032	0.050	415.067	6.881	14.000	0.089
1603	LAKE COEUR D'ALENE	0.017	0.040	380.342	10.391	12.200	0.095
1604	DWORSHAK RESERVOIR	0.010	0.000	491.006	2.420	7.400	0.009
1605	HARIDY	0.020	0.075	366.206	11.112	14.600	0.013
1606	HAYDEN LAKE	0.013	0.040	243.500	2.707	11.000	0.003
1607	ISLAND PARK RESERVOIR	0.034	0.050	391.770	9.122	12.000	0.012
1608	LAKE LOWELL	0.070	0.070	477.111	25.309	14.400	0.015
1609	MAGIC RESERVOIR	0.302	0.170	480.750	7.322	14.700	0.020
1610	PALISADES RESERVOIR	0.024	0.030	345.420	2.067	12.000	0.007
1611	PRIEST RAPIDS	0.013	0.090	234.000	4.600	9.002	0.007
1612	PRIEST TWIN LAKES	0.016	0.050	370.090	2.310	13.600	0.009
1613	PRIEST TWIN LAKES	0.017	0.045	300.343	4.006	8.250	0.004

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	SUB-MEDIAN SEC	MEDIAN CHLORA	15-MIN 20	MEDIAN DISS ORTHO P
1601	[illegible] FALLS RESERVOIR	0 (0)	17 (1)	0 (1)	8 (1)	21 (2)	0 (0)
1602	CAYUGA LAKE	33 (4)	54 (6)	17 (2)	42 (5)	4 (0)	50 (5)
1603	LAKE [illegible] D'ALENE	67 (8)	96 (11)	50 (6)	25 (3)	67 (8)	83 (10)
1604	[illegible] RESERVOIR	96 (11)	17 (1)	25 (2)	83 (10)	100 (12)	50 (5)
1605	[illegible]	42 (5)	33 (4)	75 (9)	17 (2)	4 (0)	25 (3)
1606	[illegible] LAKE	96 (11)	96 (11)	92 (11)	75 (9)	75 (9)	100 (12)
1607	[illegible] PARK RESERVOIR	25 (3)	71 (8)	42 (5)	33 (4)	54 (6)	33 (4)
1608	LAKE [illegible]	0 (1)	42 (5)	0 (0)	8 (0)	33 (4)	17 (2)
1609	[illegible] RESERVOIR	17 (2)	8 (0)	33 (4)	58 (6)	21 (2)	8 (1)
1610	PALISADES RESERVOIR	58 (6)	17 (1)	83 (10)	100 (12)	54 (6)	75 (9)
1611	[illegible] PAYETTE	83 (10)	54 (6)	100 (12)	67 (8)	83 (10)	67 (8)
1612	[illegible] TWIN LAKES	75 (9)	71 (8)	58 (7)	92 (11)	42 (5)	58 (5)
1613	[illegible] TWIN LAKES	58 (7)	83 (10)	67 (8)	58 (7)	92 (11)	92 (11)